

This listing of claims will replace all prior versions of claims in the application.

Claims 1-123. (cancelled)

Claim 124. (currently amended) A method for plating a semiconductor microchip wafer substrate, comprising:

electrolytically depositing copper onto a semiconductor microchip wafer substrate having microvias or trenches from an electroplating composition that comprises at least one soluble copper salt, an electrolyte, a suppressor agent, and one or more brightener compounds having a molecular weight of about 1000 or less and that are present in a concentration of at least about 1.5 mg per liter of the electroplating composition.

Claim 125. (previously presented) The method of claim 124 wherein the brightener concentration is at least about 2 mg per liter of the electroplating composition.

Claim 126. (previously presented) The method of claim 124 wherein the brightener concentration is at least about 3 mg per liter of the electroplating composition.

Claim 127. (previously presented) The method of claim 124 wherein the brightener concentration is at least about 4 mg per liter of the electroplating composition.

Claim 128. (previously presented) The method of claim 124 wherein the brightener concentration is at least about 5 mg per liter of the electroplating composition.

Claim 129. (previously presented) The method of claim 124 wherein the brightener concentration is at least about 6 mg per liter of the electroplating composition.

Claim 130. (previously presented) The method of claim 124 wherein the brightener concentration is at least about 8 mg per liter of the electroplating composition.

Claim 131. (previously presented) The method of claim 124 wherein the brightener concentration is at least about 10 mg per liter of the electroplating composition.

Claim 132. (previously presented) The method of claim 124 wherein the brightener concentration is at least about 15 mg per liter of the electroplating composition.

Claim 133. (cancelled)

Claim 134. (currently amended) The method of claim 124 +33 wherein the suppressor agent is a polyether.

Claim 135. (previously presented) The method of claim 124 wherein the electroplating composition comprises a halide ion source.

Claim 136. (previously presented) The method of claim 124 wherein the microchip wafer substrate is electrically attached to a cathode of the system.

Claim 137. (previously presented) A method for plating a semiconductor microchip wafer substrate, comprising:

electrolytically depositing copper onto a semiconductor microchip wafer substrate having microvias or trenches from an electroplating composition that comprises at least one soluble copper salt, an electrolyte, and one or more brightener compounds present in a concentration of at least about 1.5 mg per liter of the electroplating composition,

wherein the one or more brightener compounds comprise a group of the formula R'-S-R-SO₃X where R is optionally substituted alkyl, optionally substituted heteroalkyl, optionally substituted aryl or optionally substituted heterocyclic; and X is a counter ion.

Claim 138. (previously presented) The method of claim 137 wherein the one or more brighteners correspond to one of the following formulae:



wherein R is optionally substituted alkyl; Ar is optionally substituted aryl; and X is a counter ion.

Claim 139. (previously presented) The method of claim 137 wherein the one or more brighteners are selected from the group consisting of n,n-dimethyl-dithiocarbamic acid-(3-sulfopropyl)ester; 3-mercaptopropylsulfonic acid; carbonic acid-dithio-o-ethyl-s-ester with 3-mercaptopropane sulfonic acid; bisulfopropyl disulfide; 3-(benzthiazolyl-s-thio)propyl sulfonic acid; and 3-mercaptopropane-1-sulfonate.

Claim 140. (currently amended) The method of claim 137 wherein the one or more brighteners are comprise a sulfonopropyl bisulfopropyl-disulfide compound.

Claim 141. (previously presented) The method of claim 137 the one or more brightener compounds have a molecular weight of about 1000 or less.

Claim 142. (previously presented) The method of claim 137 wherein the brightener concentration is at least about 2 mg per liter of the electroplating composition.

Claim 143. (previously presented) The method of claim 137 wherein the brightener concentration is at least about 3 mg per liter of the electroplating composition.

Claim 144. (previously presented) The method of claim 137 wherein the brightener concentration is at least about 4 mg per liter of the electroplating composition.

Claim 145. (previously presented)The method of claim 137 wherein the brightener concentration is at least about 5 mg per liter of the electroplating composition.

Claim 146. (previously presented)The method of claim 137 wherein the brightener concentration is at least about 6 mg per liter of the electroplating composition.

Claim 147. (previously presented)The method of claim 137 wherein the brightener concentration is at least about 8 mg per liter of the electroplating composition.

Claim 148. (previously presented)The method of claim 137 wherein the brightener concentration is at least about 10 mg per liter of the electroplating composition.

Claim 149. (previously presented)The method of claim 137 wherein the brightener concentration is at least about 15 mg per liter of the electroplating composition.

Claim 150. (previously presented)The method of claim 137 wherein the electroplating composition further comprises a suppressor agent.

Claim 151. (previously presented)The method of claim 150 wherein the suppressor agent is a polyether.

Claim 152. (previously presented)The method of claim 137 wherein the electroplating composition comprises a halide ion source.

Claim 153. (previously presented)The method of claim 137 wherein the microchip wafer substrate is electrically attached to a cathode of the system.

Claim 154. (new) A method for plating a semiconductor microchip wafer substrate, comprising:

electrolytically depositing copper onto a semiconductor microchip wafer substrate having microvias or trenches from an electroplating composition that comprises at least one soluble copper salt, electrolyte, suppressor agent, and one or more brightener compounds present in a concentration of at least about 1.5 mg per liter of the electroplating composition,

wherein the one or more brightener compounds comprise a group of the formula R'-S-R-SO₃X where R is optionally substituted alkyl, optionally substituted heteroalkyl, optionally substituted aryl or optionally substituted heterocyclic; and X is a counter ion.

Claim 155. (new) The method of claim 154 wherein the one or more brighteners correspond to one of the following formulae:



wherein R is optionally substituted alkyl; Ar is optionally substituted aryl; and X is a counter ion.

Claim 156. (new) The method of claim 154 wherein the one or more brighteners are selected from the group consisting of n,n-dimethyl-dithiocarbamic acid-(3-sulfopropyl)ester; 3-mercaptopropylsulfonic acid; carbonic acid-dithio-o-ethyl-s-ester with 3-mercaptop-1-propane sulfonic acid; bisulfopropyl disulfide; 3-(benzthiazolyl-s-thio)propyl sulfonic acid; and 3-mercaptopropane-1-sulfonate.

Claim 157. (new) The method of claim 154 wherein the one or more brighteners comprise a bisulfonopropyl disulfide compound.

Claim 158. (new) The method of claim 154 the one or more brightener compounds have a molecular weight of about 1000 or less.

Claim 159. (new) The method of claim 154 wherein the suppressor agent is a polyether.

Claim 160. (new) A method for plating a semiconductor microchip wafer substrate, comprising:

electrolytically depositing copper onto a semiconductor microchip wafer substrate having microvias or trenches from an electroplating composition that comprises at least one soluble copper salt, an electrolyte, and one or more brightener compounds that comprise a sulfonopropyl disulfide compound and the one or more brightener compounds present in a concentration of at least about 1.5 mg per liter of the electroplating composition.

Claim 161. (new) The method of claim 160 wherein the brightener concentration is at least about 2 mg per liter of the electroplating composition.

Claim 162. (new) The method of claim 160 wherein the brightener concentration is at least about 3 mg per liter of the electroplating composition.

Claim 163. (new) The method of claim 160 wherein the brightener concentration is at least about 4 mg per liter of the electroplating composition.

Claim 164. (new) The method of claim 160 wherein the brightener concentration is at least about 10 mg per liter of the electroplating composition.

Claim 165. (new) The method of claim 160 wherein the brightener concentration is at least about 15 mg per liter of the electroplating composition.

Claim 166. (new) The method of claim 160 wherein the electroplating composition further comprises a suppressor agent.

Claim 167. (new) The method of claim 166 wherein the suppressor agent is a polyether.